

Cytological studies of this kind have opened a new field of investigation which is sure to throw much light on the relationships of the important economic plants.

ENTOMOLOGY.—*The wasp Nysson hoplisivora, a parasitic relative of Hoplisus costalis.* EDWARD G. REINHARD, Canisius College, Buffalo, New York. (Communicated by S. A. ROHWER.)

It has been customary to extoll the solitary wasps as examples of altruism and industry. They are the industrious fossores, considered to be of a superior race above the ruder parasitic Hymenoptera. So they are, a very respectable clan, yet, like many noted families, they are not without a "black sheep" to stain the family honor. It was only recently that any wayward habits among the members of the Sphecoidea have been brought to light. But information is accumulating, and the evidence points to a degenerate branch, the *Nyssonini*, as a set of parasites who revel in robbery and fratricide.

The *Nyssonini* had a clear record for centuries because no one had ever investigated their manner of life. In 1887 Handlirsch voiced the first suspicion by noting how similar in appearance some of them were to the species of bees who practised parasitism. Yet nothing definite was known about the life-history of any *Nysson* until 1901 when Ferton observed the behavior of *Nysson dimidiatus* in France, and found indications of parasitic habits.

Dr. William M. Wheeler, writing in 1919, thus summarizes the knowledge of *Nysson's* habits: "According to Ferton (1901) the Gorytid *Nysson dimidiatus* is a parasite of *Gorytes elegans*. The latter digs its burrow in the sand and provisions it with larval and adult Hemiptera; the *Nysson* finds it and often enters it during the absence of *Gorytes*. If the latter happens to be at home the *Nysson* waits motionless about a dozen centimeters away, with its head turned towards the nest, till the *Gorytes* departs. Adlerz (1910) observed very similar behavior on the part of *Nysson maculatus* towards *Gorytes lunatus*. Apparently both species of *Nysson* destroy the *Gorytes* egg attached to the prey and lay their own in its place."¹

Neither Ferton nor Adlerz succeeded in finding the *Nysson's* egg or larva or any signs of parasitic depredations beyond the suspicious actions of the wasp and its forceful entry into the *Gorytes's* burrow. Barth in 1907 had made additional observations of which Dr. Wheeler was not aware. He saw in Wisconsin a *Nysson fidelis* (Cres.) rapidly

¹ *The parasitic Aculeata, a study in evolution.* Proc. Amer. Phil. Soc. 58: no. 1: 15.

scratch open and enter the nest of an absent *Gorytes canaliculatus*. The Nysson remained within for several minutes, then came out again and closed the entrance. The following day when the nest was opened, one of the cells was found to contain nine tree-hoppers and two eggs. One egg was glued to the thorax of a hopper, another smaller one was found lying unattached on the floor of the cell. This smaller egg, evidently that of Nysson, was in shape similar to the Gorytes' egg, but its surface was less shining.

These three observations seem to be the only evidence recorded in entomological literature of the singular manner of life practised by the Nysson wasps.

During the summer of 1922 while investigating the habits of *Hoplisis costalis* at Woodstock, Maryland, I made the acquaintance of an interesting Nysson previously unknown to science, which S. A. Rohwer described² as *Nysson (Brachystegus) hoplisivora*. An account of the habits of this wasp will furnish us with new material for a consideration of Nysson's parasitic behavior. The Nysson parasitoids are especially noteworthy because in all these cases the parasite bears a very close genetic relationship to its host, and according to the evolutionary doctrine it is supposed in general to have sprung from the same stock as its host species.

The host of *Nysson hoplisivora*, as well as its parasite, both belong to the subfamily Nyssoninae. It is a wasp sometimes known as *Gorytes costalis*, though *Hoplisis costalis* is now the approved form. It preys upon various species of tree-hoppers (Membracidae) which it stores away in burrows dug into the sandy earth. Five or six membracids are commonly placed in a single cell and the wasp's egg is deposited on the last one brought in, along the lateral edge of the bug's broad sternum. The mouth of the burrow is kept barricaded with a loose covering of sand which the wasp scrapes away when entering and carefully replaces when about to depart.

There were about twenty nests of *H. costalis* sunk into the sand of a brick-covered path which was the site of a thriving settlement of the solitary wasps *Philanthus gibbosus*, who capture wild bees of the family Halictidae. Both wasps build nest-mounds of about the same size, those of *Philanthus* being somewhat more spreading.

Somewhere among these nests, flying about, or resting in the neighborhood of a burrow, could always be found two or three of the Nysson wasps. They were small but very neat-appearing in their dress of dull

² Proc. Ent. Soc. Washington 25: no. 4. April, 1923.

black and the first abdominal segment gleaming with red and yellow, like a ripe apple. They would fly very low, just skimming over the surface, to pause at every sand heap, inspect it, circle about inquisitively, and dart along to the next mound. The burrows of *Philanthus* did not interest them. They delayed longest at the doors of *Hoplisus* to gather information with trembling taps of their antennae. If the owner was about, the visitor would sometimes settle herself on the ground close by, and, with watchful gaze directed at the doorway, wait quietly until *Hoplisus* had departed. At times she would enter an open gallery but come out hastily again, and warily take up a post of observation to sit awaiting. But when the coast was clear and the nest vacated, the *Nysson* would boldly break through its barricaded portal to enter the nurse-chambers below, where her depredations could be committed without detection.

For several days the lurking *Nyssons* haunted the colony before I could succeed in witnessing with full convicting evidence their sneaky methods. On July 12, early in the morning, I am watching near a clump of burrows which the *Hoplisi* has excavated. The tenent of the nearest dwelling has already gone off on her hunting expedition. A prying *Nysson* appears in the offing. She skims over to the unguarded nest and alights on the little plateau of sand. Just a slight bit of hesitation and inspection, then the *Nysson* commences to tear away at the loose sand with her front tarsal rakes. She does her work audaciously and quickly. In a moment the tunnel is exposed and the *Nysson* slips swiftly within. Only a few seconds does she tarry. Then the intruder emerges and with wonderful nonchalance, as it were, carefully rearranges the sand over the doorway. To see her you would think she was the dwelling's rightful owner and housewife. When the tunnel is once more blocked and the nest entrance obliterated, the *Nysson* calmly departs.

Was the *Nysson's* action in closing the burrow really an attempt to eliminate the traces of her forced entrance, or was it merely a tropism and remnant of the days when her more industrious ancestors were wont to throw a curtain of sand over the doorway at every departure?

In less than ten minutes, *Hoplisus* appears on the scene, she whose home had been invaded. Under her body she carries a motionless membracid. Will the wasp notice anything amiss in the arrangement of her doorway or in the sacred chambers below? The wasp proceeds as usual. She gives no evidence of alarm. The burrow is entered, her fresh capture left in the nest, and the busy matron ventures forth

again to resume her quest after choice tree-hoppers for her own—no, quite unwittingly now for another's offspring.

After an hour's hunt, *Hoplisus* returns a second time with a captive, and thus for three hours longer I leave her to perform her hunting and household duties unmolested. At length, I begin to open the invaded burrow to see what rape or ruin the despoiler has accomplished. The corridor sloped gently downward for six inches, at the terminus of which was a single oval cell. A branch gallery led off further, but only this first cell had been provisioned. It contained six *Ceresae* piled two deep in a double layer. A *Ceresa* in the upper layer bore the *Hoplisus* egg. A *Ceresa* in the lower layer bore the parasite's egg. This was so skillfully concealed and protected as to claim my astonishment. The *Nysson* had inserted it under the folded wings of the tree-hopper where it rested hidden and secure along the bug's dorsal abdomen. Repeatedly have I discovered the egg of *hoplisivora* in the cells of *Hoplisus* and it is always found tucked away in the same position.

Let us compare host egg and parasite egg. The former is more than twice as large as the latter. *Hoplisus* lays an egg which is bow-shaped, 3 mm. long, smooth, shining white, and glued by its caudal pole to the sternum of the tree-hopper alongside the hind coxa. It arches forward along the body to the hopper's head. The parasite, *Nysson hoplisivora*, deposits an egg which is fairly straight and cylindrical, 1.34 mm. long, its greatest width 0.44 mm. The shell is dull white, tough, with a "goose-flesh" texture that shows under the microscope as numerous small excrescences placed with regularity.

For one reason or another I could not succeed in tracing out the entire history of the parasite from a single individual, but, having gathered scraps of information here and there, and having pieced them together, the remainder of the story became apparent. Some scattered bits of data taken from my note-book are here placed in order:

1. (July 13, cell no. 1). This cell contained five *Membracids*. The *Nysson* egg was tucked away under the wings of a *Platycotis vittata*. There was no *Hoplisus* egg present in the cell.

2. (July 12). Six *membracids* in the cell. The *Nysson* egg and the *Hoplisus* egg, each on separate bugs.

3. (July 20). Cell contained six *membracids*, the *Nysson* egg, and the *Hoplisus* egg. The following day, 7.30 a.m., the egg of the parasite hatched. Twelve hours later the egg of the *Hoplisus* hatched.

4. (July 15, cell no. 1). Six *membracids*. The *Hoplisus* egg is near hatching; the egg of the parasite has hatched. The larva feeds for a short time, then leaves its hopper to go exploring.